

with the signal and with itself at the applicable time delays. It provides a corrected coherence spectrum given the measured coherence and power spectra. For power-law signal spectra and instrumental white noise, the correction formula takes a particularly simple and explicit form. Since many geophysical signals exhibit power-law behavior and most instrument noise spectra approach white noise, the simpli-

fied form should be widely applicable in meteorology, oceanography, geology, and planetary geophysics.

The derivation of the method and the resulting formulas for both the general case and the power-law/white-noise case may be found in the Appendix to "The Coherence Time of Mid-Tropospheric Wind Features as a Function of Vertical Scale From 300 m to 2 Km", *Journal of*

*Applied Meteorology*, Vol. 39, pp 2409-2420, December 2000.

*This work was done by Francis J. Merceret of Kennedy Space Center.*

*Inquiries concerning rights for the commercial use of this invention should be addressed to the Technology Programs and Commercialization Office, Kennedy Space Center, (321) 867-4879. Refer to KSC-12267.*

## Compact Instruments Measure Helium-Leak Rates

Compact, lightweight instruments have been developed for measuring small flows of helium and/or detecting helium leaks in solenoid valves when the valves are nominally closed. These instruments do not impede the flows when the valves are nominally open. They can be integrated into newly fabricated valves or retrofitted to previously fabricated valves. Each instrument includes an upstream and a downstream thermistor separated by a heater, plus associated analog and digital heater-control, sig-

nal-conditioning, and data-processing circuits. The thermistors and heater are off-the-shelf surface mount components mounted on a circuit board in the flow path. The operation of the instrument is based on a well-established thermal mass-flow-measurement technique: Convection by the flow that one seeks to measure gives rise to transfer of heat from the heater to the downstream thermistor. The temperature difference measured by the thermistors is directly related to the rate of flow. The calibration

curve from temperature gradient to helium flow is closely approximated via fifth-order polynomial. A microprocessor that is part of the electronic circuitry implements the calibration curve to compute the flow rate from the thermistor readings.

*This work was done by Stephen Stout and Christopher Immer of Dynacs, Inc., for Kennedy Space Center.*

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## Books and Reports

### Irreversible Entropy Production in Two-Phase Mixing Layers

This report presents a study of dissipation (irreversible production of entropy) in three-dimensional, temporal mixing layers laden with evaporating liquid drops. The purpose of the study is to examine the effects of evaporating drops on the development of turbulent features in flows. Direct numerical simulations were performed to analyze transitional states of three mixing layers: one without drops, and two that included drops at different initial mass loadings. Without drops, the dissipation is essentially due to viscous effects. It was found that in the presence of drops, the largest contribution to dissipation was made by heating and evaporation of the drops, and that at large length scales, this contribution is positive (signifying that the drops reduce turbulence), while at small scales, this contribution is negative (the drops increase turbulence). The second largest contribution to dissipation was found to be associated with the chemical potential, which leads to an increase in turbulence at large scales and a decrease in turbulence at small scales. The next smaller contribution

was found to be that of viscosity. The fact that viscosity effects are only third in order of magnitude in the dissipation is in sharp contrast to the situation for the mixing layer without the drops. The next smaller contribution — that of the drag and momentum of the vapor from the drops — was found to be negative at lower mass loading but to become positive at higher mass loading.

*This work was done by Josette Bellan and Nora Okong'o of Caltech for NASA's Jet Propulsion Laboratory. To obtain a copy of the report, "Irreversible entropy production in two-phase flows with evaporating drops," see TSP's [page 1].*

NPO-30586

### Subsonic and Supersonic Effects in Bose-Einstein Condensate

A paper presents a theoretical investigation of subsonic and supersonic effects in a Bose-Einstein condensate (BEC). The BEC is represented by a time-dependent, nonlinear Schroedinger equation that includes terms for an external confining potential term and a weak interatomic repulsive potential proportional to the number density of atoms.

From this model are derived Madelung equations, which relate the quantum phase with the number density, and which are used to represent excitations propagating through the BEC. These equations are shown to be analogous to the classical equations of flow of an inviscid, compressible fluid characterized by a speed of sound  $(g/p_0)^{1/2}$ , where  $g$  is the coefficient of the repulsive potential and  $p_0$  is the unperturbed mass density of the BEC. The equations are used to study the effects of a region of perturbation moving through the BEC. The excitations created by a perturbation moving at subsonic speed are found to be described by a Laplace equation and to propagate at infinite speed. For a supersonically moving perturbation, the excitations are found to be described by a wave equation and to propagate at finite speed inside a Mach cone.

*This work was done by Michail Zak of Caltech for NASA's Jet Propulsion Laboratory. To obtain a copy of the paper, "Sub- and supersonic effects in Bose-Einstein condensate," see TSP's [page 1].*

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